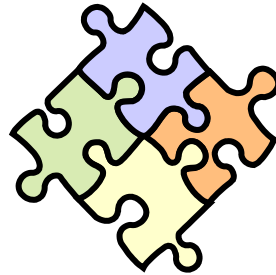


# ***Connecting to Unifying Concepts through***



## **Space Science**

Lesson Title:  
Following the Phases

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<p><b>Systems</b></p> <ol style="list-style-type: none"> <li>1. What is a system?</li> <li>2. What parts are in this system?</li> <li>3. How do the parts interact?</li> <li>4. What is the purpose of the parts interacting?</li> <li>5. What are the essential parts of the system?</li> <li>6. Name a part of the system and tell how the rest of the system would change if this part were removed. Repeat for other parts of the system.</li> </ol>	<p><b>Science Unifying Concept Questions</b></p>	<p><b>Models</b></p> <ol style="list-style-type: none"> <li>1. Give examples of different types of models.</li> <li>2. How are models useful?</li> <li>3. Why did we make this model?</li> <li>4. How is our model similar to <u>and</u> different from the natural world?</li> <li>5. Why did we choose these materials to make our model?</li> <li>6. What would make our model better able to represent our science concept?</li> </ol>
<p><b>Change</b></p> <ol style="list-style-type: none"> <li>1. Give examples of different types of change.</li> <li>2. What changes occurred in this investigation?</li> <li>3. How long did the changes take to occur?</li> <li>4. How would we describe the rate of change?</li> <li>5. How could this rate of change be made faster or slower?</li> <li>6. What did we observe that stayed the same during our investigation?</li> </ol>	<p><b>Properties &amp; Patterns</b></p> <ol style="list-style-type: none"> <li>1. What is a property?</li> <li>2. What properties of objects or phenomena did we observe?</li> <li>3. What are the essential properties that make the object or phenomena unique?</li> <li>4. How can properties be used to find patterns?</li> <li>5. What patterns did we observe during our investigation?</li> <li>6. What would happen if the pattern changes?</li> </ol>	<p><b>Survival</b></p> <ol style="list-style-type: none"> <li>1. Give examples of different types of survival.</li> <li>2. What factors determine whether or not something survives?</li> <li>3. What survived in our investigation?</li> <li>4. What interactions were necessary for survival to occur in our investigation?</li> <li>5. Why was survival important in our investigation?</li> <li>6. How could we predict survival based on our investigation?</li> </ol>

## Title: Following the Phases

Lesson focus: Identify and describe patterns of change which create phases of the Moon.

Texas Essential Knowledge and Skills (Process TEKS): 5.2B, C, D, E, 5.3C

Texas Essential Knowledge and Skills (Concept TEKS): K.7A, 1.7A, 2.7D, 3.6A, 4.6A, 5.5A, B, 5.6A

Texas Assessment of Knowledge and Skills Objective (TAKS): Earth Science

Estimated lesson time frame: Two 50 minute class periods

Materials per class:

PowerPoint presentation

Light bulb and socket connected to wall outlet (a lamp without its shade)

Materials per student:

Student notebook/journal

Scissors

Glue or tape

**Moon Cards** set (copied on paper, cut apart, stored in envelope or baggie)

**November Moon Phases** recording sheet

Pencil for shading Moons and holding Styrofoam ball

3" diameter Styrofoam ball

**Following the Phases** recording sheet

**Moon Phases - Reading Notes** (reading passage)

**Moon Phases Graphic Organizer** (reading strategy)

Blank white paper 8.5" X 11"

Lesson activity:

Suggested grouping: individuals

Safety notes:

**Note to teacher: This copyrighted activity has been used by permission of co-authors Karen Ostlund and Sheryl Mercier.**

Pre-assessment sample question: Describe what causes the changing shape of the Moon.

Before pre-assessing, build background with the students. An assumption cannot be made that all students have a background of studying the Moon. Build background with visuals, read a paragraph from the content book, a poem, or a selection from an expository book about the Moon. After building the background fill out the following chart with the students. Taking the time to build background gives the English language learner time to reconnect with what they may have learned in a different language about the Moon or have the opportunity to gain some background knowledge before the pre-assessment. Together as a class fill in the example T-Chart below.

What do I know about the changing shape of the Moon? (Complete after building background knowledge)	What would I like to learn about the changing shape of the Moon?
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## ENGAGE

1. Give each student a set of **Moon Cards**. Pair English language students for this task with a student at a higher proficiency rate or with a Native English speaker. Ask students to place the cards so that the word TOP can be read across the top of the cards. Ask students to describe the shapes of the Moon they see in the Moon Cards. Then have students arrange the pictures to create a pattern. Have students compare their pattern with another student's. How are the patterns different? Why did they arrange them in this pattern? Note to teacher: This step is intended to elicit prior knowledge and to motivate students to see if their patterns are correct or if they have misconceptions about the pattern of Moon phases. Students should keep their **Moon Cards** set for use later with **Following the Phases**.

## EXPLORE

2. Explain that students will have an opportunity to observe the Moon for 30 days and nights to explore the phases of the Moon. Give each student the **November Moon Phases** recording sheet and explain that they will draw the phase of the Moon they see each day for one month. Use the PowerPoint presentation on your CD. This presentation was made with software from [www.starrynight.com](http://www.starrynight.com)

3. As you show the PowerPoint presentation ask students to record what time and date the Moon rises and sets. Use the close-up slides of the Moon for students to look at while shading with their pencil the area of the Moon's surface that is dark, leaving the white paper to represent the area of the Moon's surface that is lighted. Do one or two examples with them on the board so that they are not reversing the dark and light areas when they record. When students have recorded several Moons ask questions to help them notice changes.

- Did the Moon rise at the same time as the day/night before? (no)
- Was it earlier or later? (later)
- How much earlier or later was it? (about 50 minutes)
- Did the Moon rise in the same position as the day/night before? (no)
- Was it a little more to the southwest or northwest? (northwest)
- Can you see the Moon during the day, during the night, or both? (answers vary with the date)
- Was the Moon visible mostly during the day or night? (answers vary with the date)

4. When students have completed their November calendar you may want to summarize by emphasizing the following points: Use visuals or role playing to show students this information or allow them to draw this particular section.

- At the New Moon, the Moon rises and sets almost at the same time as the Sun. The illuminated part of the Moon faces away from Earth, so the Moon appears invisible in the sky.
- A few days after New Moon, the Waxing Crescent Moon appears above the western horizon soon after Sunset. Each evening the Waxing Crescent Moon becomes larger and higher above the horizon.
- About a week after New Moon, the Moon reaches First Quarter and appears high in the southern sky at Sunset. The First Quarter Moon does not set until about midnight, so if you want to see it, you will have to watch late-night talk shows and go outside after the shows are finished.
- In the days following First Quarter, the Waxing Gibbous Moon continues to "grow." It appears to move further east, and it sets later in the evening.
- About two weeks after the New Moon, the Full Moon arrives, rising in the east and setting in the west. The Full Moon is visible all night long, and it sets in the west around Sunrise.
- The waning phases of the Moon are not as visible because the Moon is not visible in the early evening when most people are out and about. As the Moon wanes through gibbous, it rises later and later. By the time Third or Last Quarter rolls around, Moonrise doesn't occur until around

midnight. If you want to see a Waning Crescent Moon, you must get up early before Sunrise and look for the Moon in the eastern horizon.

- The lunar cycle (Moon phases) repeats in a period of 29.5 days. This is called a synodic period. Synodic comes from the Greek words meaning journey together, referring to the position of the Sun and Moon with respect to each other.

5. Use the **November Moon Phases Rubric** to assess students' observations. After grading, the November calendar should be folded and glued or stapled into students' journals for use during the next activity.

### Scoring Key

**4 points** = exceptionally accurate/reasonable/logical, complete, detailed

**3 points** = adequately accurate/reasonable/logical, complete, detailed

**2 points** = fairly accurate/reasonable/logical, complete, detailed

**1 point** = not accurate/reasonable/logical, complete, detailed

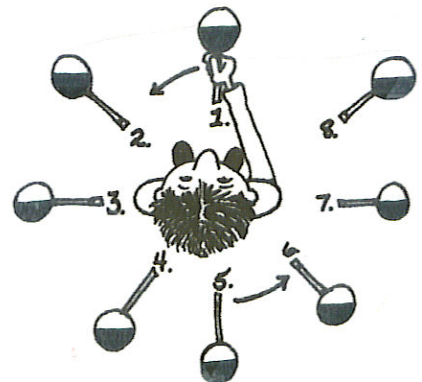
**0 points** = not attempted

November Moon Phases Rubric					
Scoring Criteria	1	2	3	4	Comments
Followed directions and completed each observation in the activity.					
Recorded Moon phases for November 1 - 4					
Recorded Moon phases for November 5 - 8					
Recorded Moon phases for November 9 - 12					
Recorded Moon phases for November 13- 16					
Recorded Moon phases for November 17 - 20					
Recorded Moon phases for November 21 - 24					
Recorded Moon phases for November 25 - 28					
Recorded Moon phases for November 29 - 30					
<b>TOTAL</b> _____/36 = _____					
<b>Comments:</b>					

### EXPLAIN

6. Explain to students that they will make a model of the Earth-Moon-Sun system to observe how the Earth, Moon, and Sun interact in the system. The Styrofoam ball represents the Moon, their head represents the Earth, and the light represents the Sun in the model. Have students put the ball on a pencil and hold their Moon ball out in front of them slightly above their heads directly facing the "Sun" which is represented by the light bulb. Teacher should model this for the students.

7. Turn off the overhead lights. Ask students how much of the Moon ball is lighted? (one-half) Point out that half of the Moon ball is lighted even though they may not be able to see the lighted half from their eyes. Have students turn counterclockwise very slowly while you stop and ask them in several positions how much of the Moon ball is lighted. Emphasize that no matter where the Moon is in its revolution around the Earth, one-half of its surface is always lighted by the Sun.



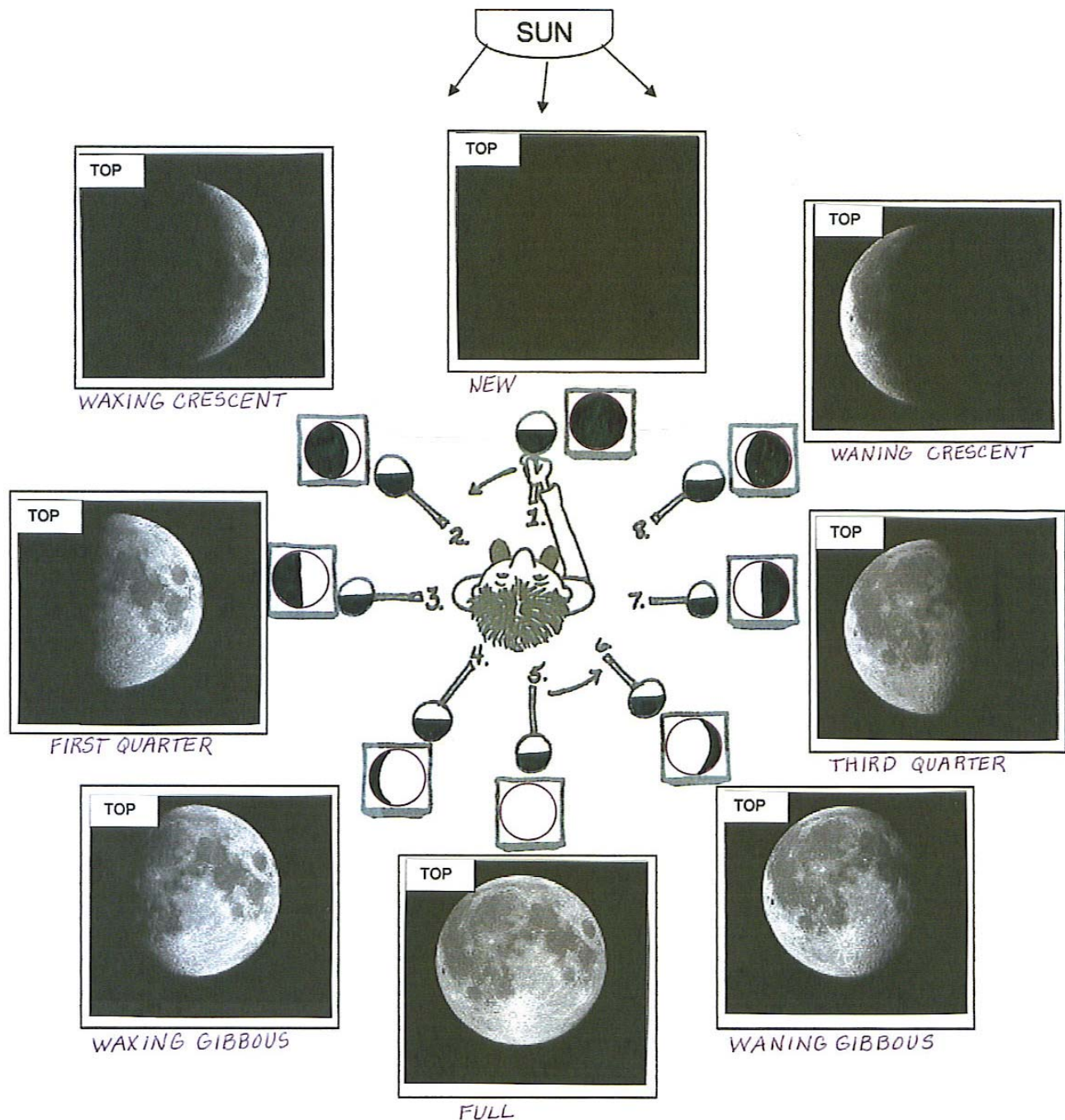
8. Give each student a **Following the Phases** recording sheet. Point their attention to the diagrams of the Styrofoam balls on the pencils. Have them shade each of the balls to show how much of the Moon ball was lighted in each position. (one-half of each ball was lighted - the side facing the light bulb).

9. During the next part have students open their journals to their completed **November Moon Phases** recording sheet and get out their **Moon Cards** set to use during this activity. Explain that their heads represent the Earth and their eyes are looking at the Moon from Earth. Complete this activity in the following steps. All steps need to be repeated at each position (New Moon position, Waxing Crescent position, First Quarter position, Waxing Gibbous position, Full Moon position, Waning Gibbous position, Third Quarter position, Waning Crescent position). This will seem redundant and time consuming but it is necessary to help students connect the spatial model to a two dimensional diagram. Pair English language learners with students who are native speakers or higher in English proficiency. Teacher will model the process with the students and then facilitate those struggling.

1. Turn off the overhead lights.
2. Have students hold out their Moon ball at the position you specify starting with the New Moon.
3. Ask students on which side of the Moon ball can they see light (right side, left side, all over, none).
4. Ask students whether the lighted area they can see is getting larger or smaller (than in the previous position).
5. Ask students whether the Moon ball is moving closer or farther from the sun (than in the previous position).
6. Ask students to name the phase represented by the Moon ball.
7. Have students sketch how the Moon ball looks in the small square on the **Following the Phases** recording sheet. Remind them to shade the dark area with their pencil and leave the white space to represent the lighted area.
8. Turn on the overhead lights
9. Ask students to locate a Moon picture on their **November Moon Phases** recording sheet that looks like their Moon ball.
10. Have students find a **Moon Card** that looks like their Moon ball.
11. Have students glue the **Moon Card** in the space next to their sketch of the Moon ball.
12. Have students write the name of the Moon phase next to each glued picture.



# Following the Phases



12. After all the steps explain that when the Moon is very close to the Sun we can't see it in the day or night because the Sun is so bright. A full cycle takes about a month or 29.3 days. Ask students how their model of the Earth-Moon-Sun system is like the actual Earth-Moon-System and how it differs. Use a simple T-chart to record the likenesses and differences of the model to the actual Earth-Moon-System. Help students understand the limitations of the model (scale is not the same, objects used to represent the Earth, Moon and Sun are not composed of the type of matter in the Earth-Moon-Sun, etc.) Use listing to explain the limitations of the model.

13. Use the **Following the Phases Rubric** to assess students' understandings of the phases of the Moon. After grading, **Following the Phases** can be folded and glued or stapled into students' journals for future review and reference.

**Scoring Key** (For English language learners, score according to language levels. See Proficiency Charts.)

**4 points** = exceptionally accurate/reasonable/logical, complete, detailed

**3 points** = adequately accurate/reasonable/logical, complete, detailed

**2 points** = fairly accurate/reasonable/logical, complete, detailed

**1 point** = not accurate/reasonable/logical, complete, detailed

**0 points** = not attempted

<b>Following the Phases Rubric</b>					
<b>Scoring Criteria</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>Evidence/Comments</b>
Followed directions and completed each step in the activity.					
1. New Moon position - shaded ball, sketched phase, glued Moon Card, wrote label					
2. Waxing Crescent position - shaded ball, sketched phase, glued Moon Card, wrote label					
3. First Quarter position - shaded ball, sketched phase, glued Moon Card, wrote label					
4. Waxing Gibbous position - shaded ball, sketched phase, glued Moon Card, wrote label					
5. Full Moon position - shaded ball, sketched phase, glued Moon Card, wrote label					
6. Waning Gibbous position - shaded ball, sketched phase, glued Moon Card, wrote label					
7. Third Quarter position - shaded ball, sketched phase, glued Moon Card, wrote label					
8. Waning Crescent position - shaded ball, sketched phase, glued Moon Card, wrote label					
<b>TOTAL</b> _____/36 = _____					
<b>Comments:</b>					

## ELABORATE

14. Have students read the **Moon Phases – Reading Notes** and follow instructions for creating the **Moon Phases Graphic Organizer**. Pair students to read notes. Teacher can “chunk” the notes which will help those students who are struggling readers. “Chunking” is eliminating unnecessary words and sentences and keeping only those sentences that contain the information students need to comprehend the concept of the lesson. They will sketch each phase of the Moon and list at least three interesting things from the **Moon Phases – Reading Notes** about each phase of the Moon.

## EVALUATE

15. Use the **Moon Phases Graphic Organizer Rubric** to assess students' reading comprehension. Assess ELL students' reading comprehension according to the language level of the English language



learner. See Proficiency Charts. After grading the graphic organizers should be glued into their notebook/journal for future review and reference.

### Scoring Key

**4 points** = exceptionally accurate/reasonable/logical, complete, detailed

**3 points** = adequately accurate/reasonable/logical, complete, detailed

**2 points** = fairly accurate/reasonable/logical, complete, detailed

**1 point** = not accurate/reasonable/logical, complete, detailed

**0 points** = not attempted

Moon Phases Graphic Organizer Rubric					
Scoring Criteria	1	2	3	4	Comments
Followed directions, completed the reading, and created the graphic organizer.					
Sketched New Moon in appropriate position and listed three interesting things from the reading.					
Sketched Waxing Crescent in appropriate position and listed three interesting things from the reading.					
Sketched First Quarter in appropriate position and listed three interesting things from the reading.					
Sketched Waxing Gibbous in appropriate position and listed three interesting things from the reading.					
Sketched Full Moon in appropriate position and listed three interesting things from the reading.					
Sketched Waning Gibbous in appropriate position and listed three interesting things from the reading.					
Sketched Third Quarter in appropriate position and listed three interesting things from the reading.					
Sketched Waning Crescent in appropriate position and listed three interesting things from the reading.					
<b>TOTAL</b> _____ /36 = _____					
<b>Comments:</b>					

16. Select Unifying Concept questions from Models, Systems, Change, and Properties and Patterns and for students to answer.

11. Use TAKS-like post-assessment questions. Create questions using student responses from the pre-assessment as multiple choice answers. Require students to give reasons why they chose or eliminated answer choices. Sample post-assessment question below:

The phases of the Moon are caused by:

- A. The spin of the Earth
- B. Different amounts of sunlight visible on the side of the moon that faces Earth
- C. Different amounts of sunlight visible on the side of the moon that faces the Sun
- D. The orbit of the Earth around the Moon.

Your reasoning: Explain why you selected this response and eliminated the other responses. \_\_\_\_\_

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Modifications:

1. Modify or reduce scoring criteria for special population students.
2. Point out words and visuals that may be helpful when following instructions and working with the materials.

Extensions:

On-line interactive student reinforcement:

Earth, Sun and Moon

[http://www.bbc.co.uk/schools/scienceclips/ages/9\\_10/earth\\_sun\\_moon.shtml](http://www.bbc.co.uk/schools/scienceclips/ages/9_10/earth_sun_moon.shtml)

Vocabulary:

Make an **ELL** vocabulary word wall using index cards. Print the definition on one side of the card and the word on the other side. Refer to the words and definitions as they come up during discussions. Students may develop a vocabulary notebook for scientific terms. The vocabulary notebook would include:

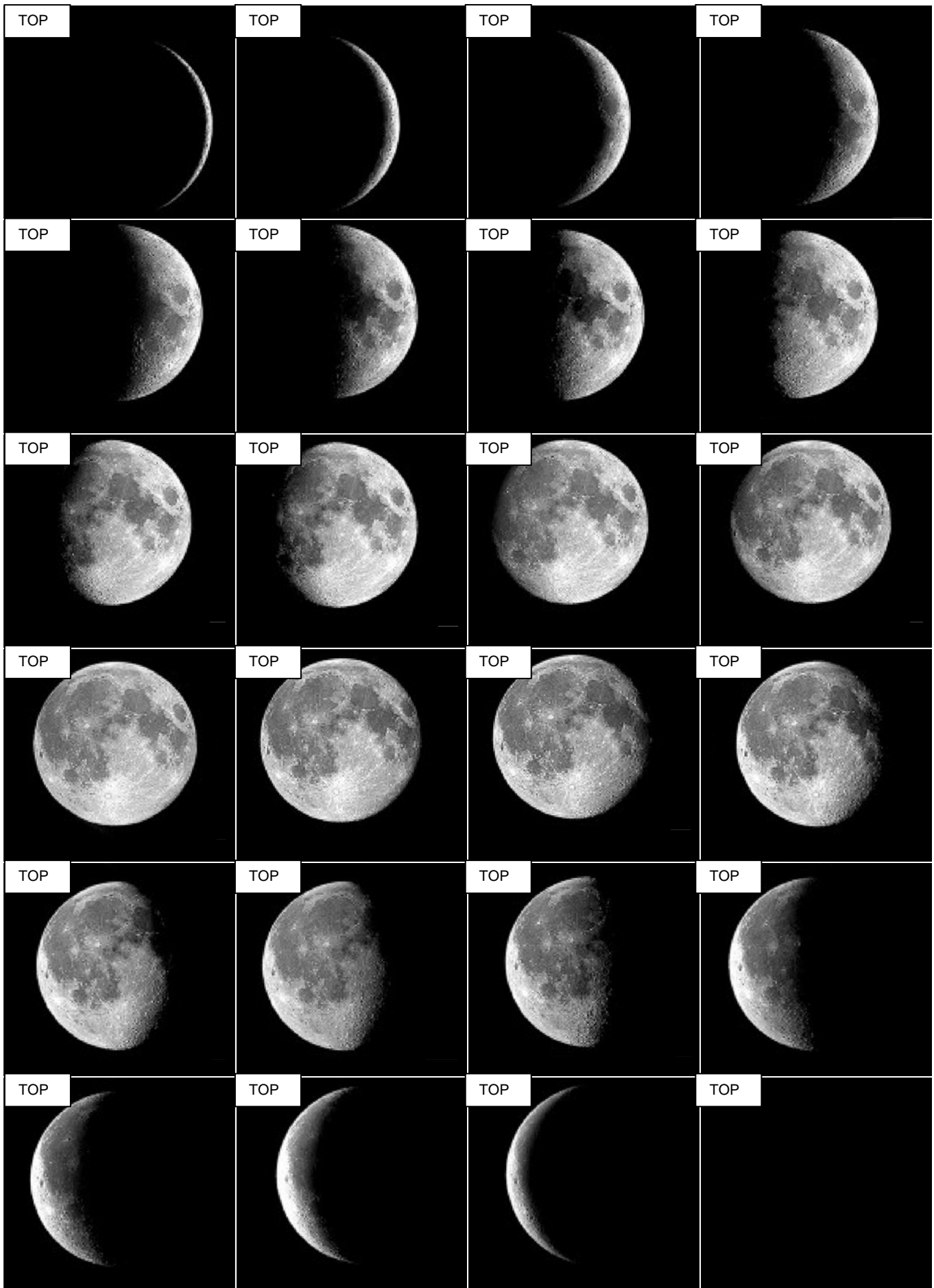
- Word
- Illustration of the word
- Student definition of the word according to what they understand and their level of comprehension
- Teacher definition

Gibbous – convex at both edges, lighted more than a quarter moon but less than a full moon

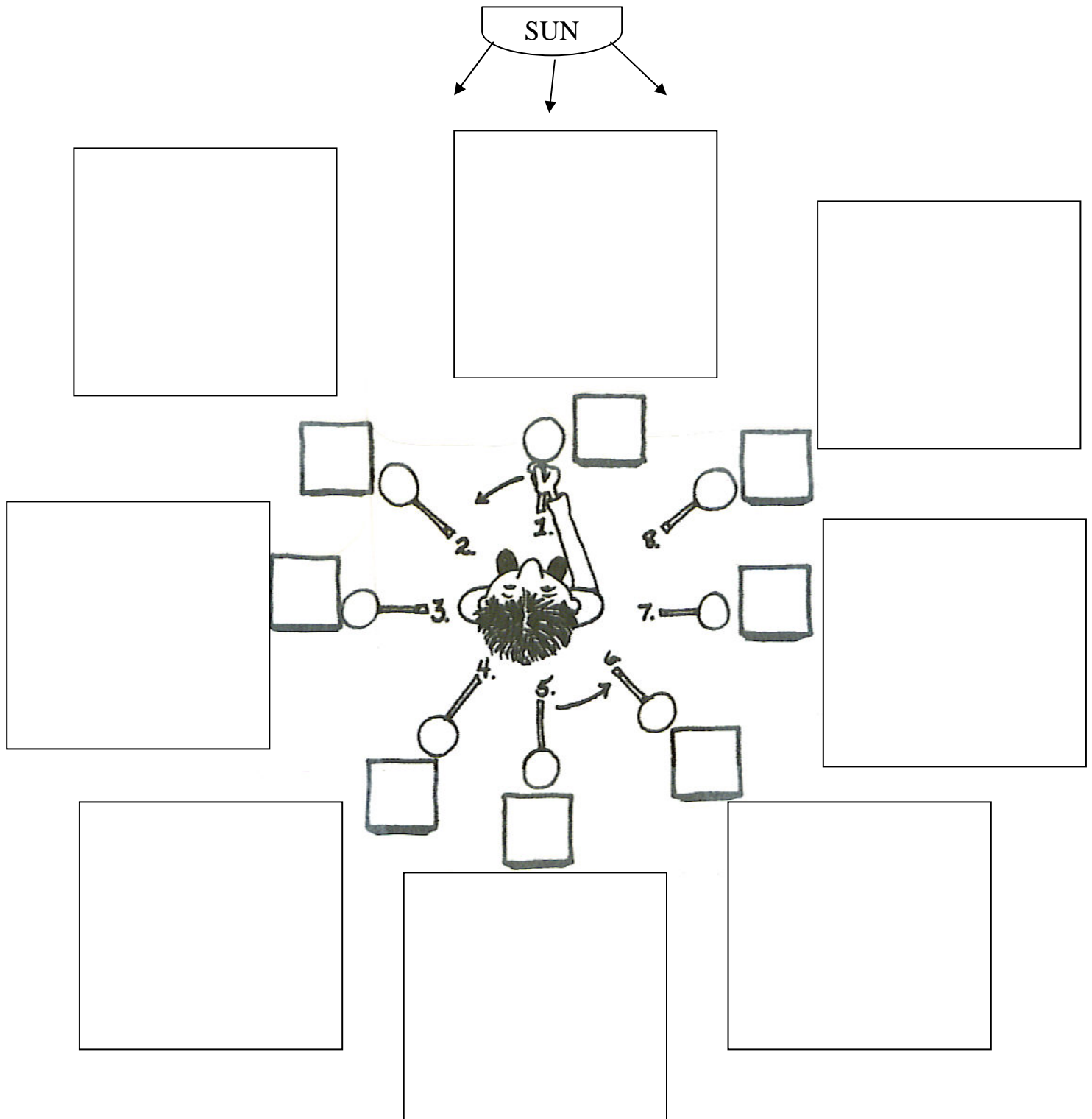
Phase - a stage in a process of change

Waxing – growing larger

Waning – growing smaller



# Following the Phases



# Moon Phases – Reading Notes

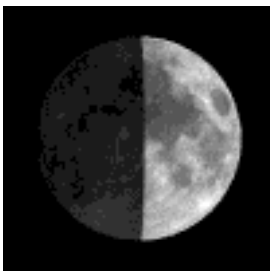
The Moon appears to rise in the east and set in the west because of the Earth's rotation. Every day, it rises an average of 50 minutes later than the day before and sets about 50 minutes later. The cycle of the phases of the Moon is repeated every 29 1/2 days.



**NEW MOON:** When we see the New Moon, the lighted side of the Moon faces away from the Earth. The Moon is between the Earth and Sun and appears in the same area of the sky where the Sun is. Generally, it rises when the Sun rises, and sets when the Sun sets. We don't see the Moon because the sunlight falls on the side of the Moon which is turned away from us.



**WAXING CRESCENT:** When we see the Waxing Crescent, a small part of the Moon appears lighted and it appears to be getting larger each day. After the New Moon, the Moon rises approximately 50 minutes after the Sun rises. The Waxing Crescent Moon is a narrow crescent, lit on the right side. It is in the sky the rest of the day following the Sun at not too great a distance. The Waxing Crescent sets about 50 minutes later than the sun in the evening.



**FIRST QUARTER:** When we see the First Quarter, the right half of the Moon appears lighted, with the lighted part growing larger on the following days. The First Quarter Moon is 7 or 8 days after the New Moon. Although it appears to be a half moon lit on the right side, it is called the First Quarter Moon. It rises about 6 hours later than the Sun, around noon. The First Quarter Moon shines half by day and half by night.



**WAXING GIBBOUS:** Gibbous means hump. When we see the Waxing Gibbous Moon, more than half of the Moon appears lighted, with more and more becoming lighted on the following days. The Waxing Gibbous Moon rises in the afternoon, and shines into the small hours of the morning. When more than half of the Moon is lit on the right side, it is a Waxing Gibbous Moon.



**FULL MOON:** Two weeks after the New Moon, the Full Moon appears. When we see the Full Moon, the lighted side of the Moon faces toward Earth. It is opposite the Sun in the sky and rises almost at sunset and sets about sunrise.



**WANING GIBBOUS:** When we see the Waning Gibbous Moon, more than half of the Moon appears lighted, with less and less becoming lighted on the following days. When the Moon is waning, it appears to be getting smaller. When more than half of the Moon is lit on the left side, it is a Waning Gibbous Moon. The Waning Gibbous Moon comes up about 50 minutes after sunset.



**THIRD OR LAST QUARTER:** When we see the Third or Last Quarter, the left half of the Moon appears lighted, with the lighted part growing smaller on the following days. The Third or Last Quarter Moon looks like a half-moon lit on the left side. It rises about 6 hours before the Sun rises, rising in the middle of the night and setting around noon.



**WANING CRESCENT:** When you see the Waning Crescent Moon, a small part of the lighted Moon is visible and grows smaller on the following days. The Waning Crescent Moon rises about 50 minutes later each night, and becomes a narrow crescent lit on the left side. It rises during the early morning hours and sets in the afternoon. It follows the Sun ever more closely, until after 29 1/2 days, we have the New Moon again and the whole cycle starts over again.



# Moon Phases Graphic Organizer

**Student Instruction Page – Use your journal for a reference!**

Materials you will use:

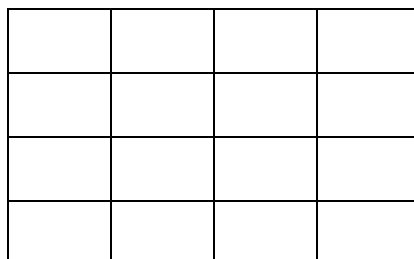
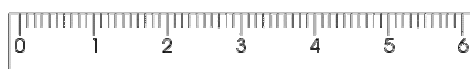


Scissors

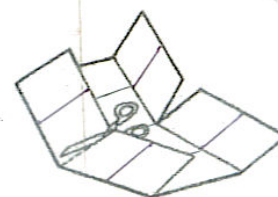
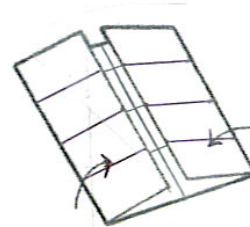


Coin


Centimeter Ruler



11" by 8.5" white paper



What to do:

1. Gently crease your paper into 16 equal sections by making hamburger and hot dog folds.
2. Use a ruler to mark lines along each crease.
3. Fold outside sections toward the center line and cut along the marks in the outside sections to make 8 small door flaps.
4. Use a coin to draw a circle on each of the door flaps. Start at the top left door flap shading this circle to represent the New Moon Phase. Continue shading the circles moving in a counter-clockwise direction to complete and label all the phases. Draw arrows to show the movement from one phase to the next.  

5. On the inside section underneath each door flap write three interesting things about the phase of the Moon that you read in the **Moon Phases Notes**.

Watch me for  
30 days.



Write  
in dates.



Shade in  
the dark parts



Leave the light  
areas white



Look for  
me at night  
and in  
day.



Explain  
the patterns  
you see.



# November Moon Phases

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

SAH  
2004